

Claims

1. A system for controllable electroporation of a membrane comprising:
 - a broad effect sub-system for providing broad energy to the membrane and
 - a narrow effect sub-system for providing narrow energy to the membrane,wherein a pore is opened or created at a position corresponding to the position of the narrow energy.
2. The system as in claim 1, wherein the broad effect sub-system is selected from the group of weakening systems consisting of electric fields, microwave energy, other electromagnetic radiation, low energy laser beams, or any combination comprising at least one of the foregoing weakening systems.
3. The system as in claim 1, wherein the energy magnitude of the broad effect sub-system is lower than the energy magnitude of electroporation systems without the narrow effect sub-system whereby random pore opening occur.
4. The system as in claim 1, wherein the area of the broad effect sub-system encompasses an area larger than the desired pore size.
5. The system as in claim 1, wherein the area of the broad effect sub-system encompasses the membrane of a cell.
6. The system as in claim 1, wherein the area of the broad effect sub-system encompasses membranes of an array of cells.

7. The system as in claim 1, wherein the area of the broad effect sub-system encompasses a region of a membrane.
8. The system as in claim 1, wherein the narrow effect sub-system is selected from the group of position localization systems consisting of laser beams, electrode tips, or any combination comprising at least one of the foregoing position localization systems.
9. The system as in claim 1, wherein the area of the narrow effect sub-system corresponds to the dimensions of the pore opening.
10. The system as in claim 1, wherein the pore has sub-micron dimensions.
11. The system as in claim 1, wherein the pore has dimensions of about 100 nanometers or less.
12. A controllable electroporation system comprising:
 - a broad effect sub-system for providing broad energy to the membrane and
 - a narrow effect sub-system for providing narrow energy to the membrane,wherein a pore is opened when both the broad effect sub-system and the narrow effect sub-system are activated.

13. A method for controllably opening a pore in a membrane comprising:
 - directing broad energy to the membrane and
 - directing narrow energy to the membrane,wherein a pore is opened or created at a position corresponding to the position of the narrow energy.
14. The method as in claim 13, wherein the broad energy is selected from the group of energy systems consisting of electric fields, microwave energy, other electromagnetic radiation, low energy laser beams, or any combination comprising at least one of the foregoing energy systems.
15. The method as in claim 13, wherein the energy magnitude of the broad energy is lower than the energy magnitude of electroporation systems without the narrow effect sub-system whereby random pore opening occur.
16. The method as in claim 13, wherein the area of the broad energy encompasses an area larger than the desired pore size.
17. The method as in claim 13, wherein the area of the broad energy encompasses the membrane of a cell.
18. The method as in claim 13, wherein the area of the broad energy encompasses membranes of an array of cells.

19. The method as in claim 13, wherein the area of the broad energy encompasses a region of a membrane.
20. The method as in claim 13, wherein the narrow energy is selected from the group of position localization energy systems consisting of laser beams, electrode tips, or any combination comprising at least one of the foregoing position localization energy systems.
21. The method as in claim 13, wherein the area of the narrow energy corresponds to the dimensions of the pore opening.
22. The method as in claim 13, wherein the pore has sub-micron dimensions.
23. The method as in claim 13, wherein the pore has dimensions of about 100 nanometers or less.
24. A cell pore opening system comprising:
a microrobotic device for holding a cell and
a system as in claim 1 for controllably opening a pore in the cell.
25. The cell pore opening system as in claim 24, wherein the broad effect sub-system comprises an electrode plate and a switchable voltage source.

26. The cell pore opening system as in claim 24, wherein the narrow effect sub-system comprises a laser.

27. A cell pore macromolecule system comprising:
a microrobotic device for holding a cell;
a system as in claim 1 for controllably opening a pore in the cell; and
a macromolecule injection device for injecting a macromolecule into the cell via the pore.

28. A method of opening a cell pore comprising:
holding a cell and
applying the method of claim 13 for controllably opening a pore in the cell.

29. A method of introducing a macromolecule in a cell comprising:
holding a cell;
applying the method of claim 13 for controllably opening a pore in the cell; and
introducing the macromolecule in the cell via the pore.

30. A system for filtering molecules or macromolecules comprising:
a plurality of membrane layers, each membrane layer including a system as in claim 1 for controllably opening a pore in the cell, each membrane layer opened to a different size to create a pore size gradient.

31. A system for filtering molecules or macromolecules comprising:
a plurality of membrane layers,
a broad effect sub-system associated with each membrane layer,
wherein each layer includes a position having a defect whereby said position is closed without activation of the broad effect sub-system and said position is opened upon activation of the broad effect sub-system.
32. The system as in claim 31, wherein said defect at each layer controls the size of the pore.
33. The system as in claim 31, wherein the magnitude of the energy of the broad effect sub-system controls the size of the pore.
34. A system for filtering molecules or macromolecules comprising:
a membrane layer including a system as in claim 1 for controllably opening a pore in the cell,
wherein the narrow effect energy sub-system comprises an array of narrow effect energy sub-sub-systems.
35. A system for filtering molecules or macromolecules comprising:
a membrane layer including a system as in claim 1 for controllably opening a pore in the cell,
wherein the narrow effect energy sub-system comprises an array of lasers.

36. A system for filtering molecules or macromolecules comprising:
a membrane layer including a system as in claim 1 for controllably opening a pore in the
cell,
wherein the narrow effect energy sub-system comprises a beam steering device associated with a
source of electromagnetic energy.
37. A controllable pore opening device comprising:
a bilayer cell membrane;
a laser beam source; and
an electric field source,
wherein a laser beam from laser beam source is applied to a position on the bilayer cell
membrane to define a location of a pore opening and an electric field from the electric field source
source is applied to open the pore.
38. The controllable pore opening device as in claim 37, wherein the bilayer cell membrane
comprising phospholipid.
39. The controllable pore opening device as in claim 37, whereby the laser beam excites the
molecules in the locale thereby reducing the amount of energy required from the electric field to
open the pores, wherein the electric field may be weaker than an electric field value required to
open the pores in absence of the laser beam.
40. A filter device comprising the controllable pore opening device as in any of claims 37-39.

41. A separation device comprising multiple filters as in claim 40 stacked together with different voltages applied to each filter thereby differing the pore size.
42. A filter device as in claim 40, wherein laser beam source is capable of directing a laser beam to a plurality of locations on the membrane thereby defining different locations for pore openings when electric field is applied.
43. A filter device as in claim 42, wherein pore size is varied by properties of the membrane or by variation in level of electric field, further comprising a plurality of containers associated with intended locations on the membrane for application of the laser beam.
44. A method of separating particles comprising
providing a bilayer membrane;
directing a laser beam to a position on the membrane;
applying an electric field to open a pore at the position on the membrane, whereby particles smaller than the pore size will be separated.
45. A method of separating particles comprising
providing a plurality of bilayer membranes in a stack;
directing a laser beam to a position on the membrane;
applying a separate electric field to each membrane to open pores in each membrane.

46. A method as in claim 45, wherein the electric field to at least one of the plurality of membranes is varied to change the opening size.

47. A method of separating particles comprising
providing a bilayer membrane;
directing the laser beam to a first position on the membrane;
applying an electric field to open a pore at the first position on the membrane, whereby particles smaller than the first pore size will be separated and collected in a first container,
directing the laser beam to a second position on the membrane;
applying an electric field to open a pore at the second position on the membrane, whereby particles smaller than the second pore size will be separated and collected in a second container.